PICKLEWEED SALINITY: TERMINOLOGY AND MECHANISM

Source Documentation Memo — Ballona Wetlands Context

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1. Purpose

This memo compiles publicly available agency, academic, and historical sources addressing two questions: (a) whether pickleweed (Salicornia/Sarcocornia spp.) is more accurately described as "salt-tolerant" than as a "saltwater plant," and (b) what mechanisms could account for pickleweed persisting in areas of the Ballona Wetlands that pond seasonally with rainwater.

This memo does not take a position on causes of hydrologic change at Ballona, does not assign responsibility to any party, and is not an advocacy document. It is offered as a starting point for further inquiry. Recipients are encouraged to independently verify every citation and to reach their own conclusions; source URLs are provided for that purpose. This memo synthesizes existing published sources and does not introduce new field observations or analyses.

2. Terminology

In the botanical and agency literature, pickleweed (Salicornia/Sarcocornia spp.) is described as a halophyte: a plant tolerant of saline conditions rather than dependent upon standing seawater. It regulates internal salt through succulence (dilution) and shedding of salt-laden tissue, allowing persistence across a range of salinities.

CNPS, for example, describes Sarcocornia pacifica as having succulent stems that dilute salts and shed tissue to regulate internal salinity (vegetation.cnps.org/alliance/458).

As one taxonomic reference, the USDA PLANTS Database lists the accepted name for this species as Sarcocornia pacifica (synonym Salicornia pacifica; symbol SAPA30). plants.usda.gov/home/plantProfile?symbol=SAPA30

3. Mechanistic Literature on Soil Salinity Under Restricted Flushing

3.1 General dynamic

Tidally restricted salt marshes can become hypersaline or hyposaline, and flooded or parched, depending on seasonal precipitation and evaporation patterns (Griffith 2010, citing Zedler et al. 1980; Josselyn 1983; St. Omer 1994). library.elkhornslough.org

A general halophyte-ecology synthesis *(a synthesis, not primary research)* describes the same dynamic: rainfall can briefly dilute soil salinity in restricted marshes, after which evaporation re-concentrates salts already present, sometimes to hypersaline levels (>10%). sciencedirect.com/topics

Evaporative concentration can maintain elevated soil salinity without ongoing tidal inundation, regardless of the original source of the salts; this general mechanism has not been independently confirmed for any specific Ballona location.

3.2 Species-specific evidence from Southern California salt marshes

Zedler (1983) examined three Southern California salt marshes following heavy rainfall in 1978 and 1980 and found effects that scaled with the degree and duration of salinity change. A short-term reduction in soil salinity at Tijuana Estuary was followed by a 40% increase in *Spartina foliosa* biomass, and a longer period of brackish-water influence at Los Peñasquitos Lagoon was followed by a 160% increase in August *Salicornia virginica* biomass. At the San Diego River, by contrast, continuous freshwater flow (augmented by reservoir discharge) leached most of the marsh's soil salts, and *Salicornia virginica* was replaced by freshwater marsh species. Zedler, J.B. (1983), "Freshwater impacts in normally hypersaline marshes," *Estuaries* 6:346–355. link.springer.com/content/pdf/10.2307/1351393.pdf

The study illustrates that freshwater effects on pickleweed cannot be evaluated independently of the resulting soil salinity.

3.3 Additional quantitative / process-based studies

Although neither study examines Ballona or pickleweed specifically, both illustrate that small, sustained salinity increases can produce disproportionate ecological effects: Wang et al. (2023) modeled a **2–3 psu soil-salinity threshold** for nonlinear changes in productivity and methane flux in low-salinity tidal wetlands (*Estuaries and Coasts* 46:1808–1828, pubs.usgs.gov/publication/70247431); and Solohin et al. (2020) found that experimental seawater addition to a tidal freshwater marsh reduced root production and caused roughly 2.8 cm of soil-elevation loss over 3.5 years relative to freshwater controls (*Ecology* 101(12):e03148, pubmed.ncbi.nlm.nih.gov/33459360).

4. Comparative Restoration Literature

A UK managed-realignment study documents halophyte distribution reorganizing along fine-scale, elevation-linked salinity gradients as tidal exchange and ponding were re-established after a breach, rather than responding uniformly across the site (*Journal of Coastal Conservation*, 2015). link.springer.com/article/10.1007/s11852-015-0390-z

This example is from outside California and is offered only as a comparative illustration, not as evidence about Ballona.

5. Ballona-Specific Documentation

5.1 Regulatory record (TMDL)

The same technical document is available, with identical content, from both EPA Region 9 (archived: 19january2017snapshot.epa.gov) and the Los Angeles Regional Water Quality Control Board (current host: waterboards.ca.gov).

The TMDL documents anthropogenic depressions from historic fill and infrastructure that pond intermittently: platforms and access roads built in Area A in the 1920s "created depressions where water continues to pond sporadically" (Table 1). It also identifies Salicornia virginica as a wetland-dependent, salinity-associated species, and separately notes an instance where increased freshwater/rainfall input was associated with a decline in Salicornia cover relative to an exotic species — an observation that is consistent with the broader literature describing pickleweed distribution as closely associated with salinity across a range of conditions, rather than increasing uniformly with it.

5.2 Response to Comments (March 26, 2012)

This document provides additional narrative on hydromodification and habitat effects and clarifies agency responses to public comments on the TMDL's findings. 19january2017snapshot.epa.gov (response document)

5.3 Historical vegetation survey (1981)

Gustafson & van de Hoek (1981), a historical flora survey of Ballona, found that rainy-season ponding near Lincoln Blvd. in one area was dominated by Cotula coronopifolia, Lythrum hyssopifolia, and Spergularia marina rather than pickleweed, indicating that pickleweed recolonization of ponded ground at Ballona is not uniform across the Reserve and is consistent with localized differences in soil salinity. urbanwildlands.org/Resources/BiotaofBallona1981.pdf

Any claim about a particular location should be tied to conditions documented at that specific parcel or depression rather than generalized across the site.

6. Discussion

Taken together, the sources above are consistent with the following general observations, which recipients may wish to test against site-specific data:

- Pickleweed presence at a given location is commonly associated with elevated soil or porewater salinity; the source of the water (tidal, stormwater, or rain) alone does not determine pickleweed presence.

- Tidally restricted or poorly flushed ground can become intermittently hypersaline through evaporative concentration of salts already present in the soil, even where the standing water at any given time is fresh rainwater.
- The relationship with freshwater input appears to depend on the degree and duration of the resulting change in soil salinity, rather than on direction alone: moderate or seasonal freshwater that lowers soil salinity without eliminating it has been associated with increased pickleweed biomass, whereas sustained freshwater flow sufficient to leach most soil salts has been associated with the loss of pickleweed and its replacement by freshwater marsh species (Zedler 1983); increased freshwater/rainfall input at Ballona was also associated with a decline in Salicornia cover relative to an exotic species.
- Because soil salinity at Ballona varies by location, any statement about a specific pond or depression should be supported by conditions documented at that location rather than generalized to the Reserve as a whole.

These observations describe a plausible mechanism grounded in the cited literature; they are not a substitute for site-specific soil or porewater salinity measurements, which would be needed to confirm conditions at any particular Ballona location.

This memo addresses terminology and ecological mechanisms only. It does not evaluate restoration alternatives or recommend any management action.

7. Reference List

- CNPS Vegetation Alliance — Sarcocornia pacifica: vegetation.cnps.org/alliance/458
- USDA PLANTS Database — Sarcocornia pacifica (symbol SAPA30): plants.usda.gov/home/plantProfile?symbol=SAPA30
- Griffith, A.B. (2010), Pickleweed: Factors That Control..., Elkhorn Slough: library.elkhornslough.org
- Zedler, J.B. (1983), "Freshwater impacts in normally hypersaline marshes," Estuaries 6:346–355: link.springer.com/content/pdf/10.2307/1351393.pdf
- Halophyte, ScienceDirect Topics (tertiary synthesis): sciencedirect.com/topics
- Wang, H., Krauss, K.W., Noe, G.B., Dai, Z. & Trettin, C.C. (2023), "Soil Salinity and Water Level Interact to Generate Tipping Points in Low Salinity Tidal Wetlands Responding to Climate Change," Estuaries and Coasts 46:1808–1828: pubs.usgs.gov/publication/70247431
- Solohin, E., Widney, S.E. & Craft, C.B. (2020), "Declines in plant productivity drive loss of soil elevation in a tidal freshwater marsh exposed to saltwater intrusion," Ecology 101(12):e03148: pubmed.ncbi.nlm.nih.gov/33459360
- Salinization during salt-marsh restoration after managed realignment, Journal of Coastal Conservation (2015): link.springer.com
- California Regional Water Quality Control Board, Los Angeles Region. Ballona Creek Wetlands TMDLs for Sediment and Invasive Exotic Vegetation. Final staff report / Basin Plan amendment record. Also archived by U.S. EPA Region 9. waterboards.ca.gov | EPA archived snapshot
- Ballona Creek Wetlands TMDL, Response to Comments (March 26, 2012): 19january2017snapshot.epa.gov (response)
- Gustafson, R.J. & van de Hoek, R.J. (1981), Biota of Ballona (Ballona Vegetation), hosted by the Urban Wildlands Group: urbanwildlands.org/Resources/BiotaofBallona1981.pdf

Verification note: all URLs above were checked for accessibility as of July 11, 2026. This memo is a compilation of publicly available sources and expresses no position on any pending regulatory, legal, or restoration-planning question. Recipients are encouraged to independently verify each citation and to consult the underlying documents directly.